SCIENCE.

FRIDAY, OCTOBER 24, 1884.

COMMENT AND CRITICISM.

PROFESSOR COTTERILL, in an appendix to his new 'Applied mechanics,' describes the organization of the school of engineering in the Royal naval college at Greenwich. He states that the training of the students in the practice of naval architecture and of engineering takes place in the dockyards before entering the college, and during the three summer months in which the college is closed. For such training he considers the college-workshop a very imperfect substitute, and that it occupies time 'which may be better spent elsewhere.' He further deprecates the use of models in teaching such students, remarking that the engineer does not use models, but drawings. He considers that models are of little value for such purposes, and would even condemn their use to demonstrate the laws of motion. He is, however, in favor of their use in explaining mechanical principles. Professor Cotterill approves of the 'mechanical laboratory' in which experimental investigation can be carried on, and in which mechanics can be studied experimentally. He also would allow the use of the school-workshop in the 'lower grades of technical instruction.'

These views of so distinguished and experienced an educator will probably attract much attention from those who are engaged in similar work. It is a question, however, whether they will be very generally indorsed in this country, or indeed in any European country, if we may judge from the fact that the methods which he condemns are those which are most rapidly coming into use on both sides the Atlantic. In the discussion which took place in section D of the American association at Philadelphia, there seemed to be no difference of opinion on this point. All were apparently agreed that the school-workshop is the place in which the student should learn the use of the tools in the several trades, and that systematic instruction there is vastly more profitable than any that the best of shops engaged in purely commercial work can give. There may, however, be some question whether the same systematic instruction in the large shop or in the dockyards ('navy-yards') might not be still more fruitful and profitable. The only point which seemed to be thought important as a question to be settled, in the discussion referred to, was the relative value of the workshop conducted purely as a classroom and that in which a certain amount of commercial work is constantly carried on.

THE U. S. artillery school at Fort Monroe has the following paragraph among its recently approved regulations: "To the end that the school shall keep pace with professional progress, it is made the duty of instructors and assistant instructors to prepare and arrange, in accordance with the programme of instruction, the subject-matter of the courses of study committed to their charge. The same shall be submitted to the staff; and, after approval by that body, the same shall become the authorized text-books of the school, be printed at the school, issued, and adhered to as such." If all the courses of study in the school were strictly technical, or if all the instructors there were eminent specialists, this plan of fostering home products would doubtless work to the advantage of the students; but in such subjects as geology, botany, or zoölogy, in which the ordinary forms of instruction cannot be improved by special adaptation to artillery practice, we believe that nothing is gained by neglecting to use the generally approved text-books of the science. The work on geology lately published by the school does not dispel this belief.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

American geological railway-guide.

I have commenced revising my geological railway-guide for a second and much improved edition. I should be glad if persons who have used the book, and made notes of corrections and additions, would send such corrections or additions to me; or, if it will be a saving of labor, it will be a great favor to me if they will send me their copies of the book by mail; and I will return them, and refund all postage.

James Macfarlane.

Towanda, Penn.

A wider use of scientific libraries.

In *Science* for Oct. 3, your editorial calls attention to the need of making scientific libraries more widely useful. Perhaps some of your readers will be glad to know the liberal policy of the Boston society of natural history. The society is willing to send such books as can be replaced, to students in any part of the country, at their expense of course; asking from strangers a deposit of twice the market-value of the books so sent, as a guaranty against loss. This is an example which may well be followed by all special libraries.

Edward Burgess, *librarian.*

Boston, Oct. 17.

Eye-pieces of the meridian circle at Washburn observatory.

In vol. ii. of the Publications of the Washburn observatory, p. 28, I have incorrectly said that the eye-pieces furnished by the Messrs. Repsold of Hamburg with our meridian circle were not Steinheil achromatics. I made this statement after receiving a letter from the firm of Steinheil & Co., which I erroneously supposed to convey this meaning.

Edward S. Holden.

Madison, Wis., Oct. 14.

THE OCTOBER MEETING OF THE NATIONAL ACADEMY OF SCIENCES.

The autumn session of the National academy was held last week at Newport, R.I. The time and place did not combine to a very successful gathering, the hotels having just closed their doors upon the exodus of summer visitors, while many a college-professor was still too much entangled in the work of an opening year to be able to leave his duties. At the beginning of the meeting on Tuesday, indeed, it looked as though a two-days' session was all that could be counted on; but so many of the papers provoked discussion, that the session lasted, as usual, into Friday, with only half an hour devoted to business; and the number of papers finally offered surpassed that of the year before. Twenty-three of the ninety-three members were present, and twenty-three papers were presented.

The meeting was not marked by any paper of exceptional importance; but most of them were of general interest, and provoked extended discussion. Perhaps that which awakened the liveliest interest was the one in which Dr. E. B. Tylor of Oxford, who addressed the academy by request, gave his observations upon our native tribes, and called attention to the parallelism of their customs and those of widely distant races. He dwelt at length upon the distinction which should be drawn between the origin of identical customs in separate groups of men, some of which are due to the descent of such groups from one primordial stock, and some have arisen spontaneously from similar psychic conditions. To the former, Ray Lankester had applied the term 'homogeny,' and, to the latter, 'homoplasy.' He asked the academy to tell him to which class so complicated a symbol as the pentagram belonged, which is used both by the Indians and the Asiatic astrologers. Professor Hilgard thought that such a symbol would arise spontaneously, as only in that form could a stellar figure be produced by the use of one continuous line. Major Powell believed that a third class should be added, to include arts and customs borrowed from neighbors, — a class which he was accustomed to call 'origin by acculturation.'

Among the physical papers, astronomy, as usual, held a leading place. Professor Langley offered the academy a continuation of his observations on the temperature of the moon's surface, as studied by the bolometer, showing that it must be even lower than two hundred degrees below zero, Centigrade. Professor Valentiner of Carlsruhe, by invitation of the academy, gave in his own language an account of the meridian-work he intended to undertake at the observatory, recently removed from Mannheim, and the installation of which would be completed by the middle of next year. His principal work was to be the observation of all stars, up to the eighth magnitude, between the equator and 22° south latitude, and he hoped to accomplish the task in twelve years. Dr. Peters of Clinton stated what progress he had made in determining the stars in the star-catalogue of Ptolemy's Almagest, and gave a very interesting account of his studies of the manuscripts extant, and the errors which had crept into them, exhibiting photographs of some codices.

Mr. C. S. Peirce explained some of the errors still needing correction in pendulum observations, particularly such as were due to the flexure of the pendulum. He presented the outline of a scheme for a gravitation sur-

vey of the entire country, indicating the position of points in the eastern portion of the country which he thought most desirable to occupy, in which the stations would be about two hundred miles apart, regions of geological disturbance avoided, but their sides occupied, together with the summits of the higher mountains. Seven or eight stations could be occupied in a year, and thus a series of curves secured which would give us the form of the geoid; i.e., of the surface beneath the continent where the force of gravity was uniform.

In an interesting communication on the theory of atomic volumes, Dr. Wolcott Gibbs made the point that writers had left out of consideration the volume of the interstitial spaces. Mr. Fairman Rogers described some special features of Grant's difference-engine, showing, that, by its method of calculating tables by successive differences, it was an improvement on previous arithmometers, eliminating many sources of error. Those present who had used such calculating machines believed them to be more useful in mathematical than in astronomical work.

Of papers other than physical, much interest attached to the exhibition, by Mr. Pumpelly, of the first attempt to obtain a composite photograph of the members of the academy. Thirty-one photographs were obtained at the last May meeting of the academy; and three composites had been made from the full-face views, — one in which all were represented, and two in which the physicists and naturalists had been separately combined. The latter two showed marked differences, the physicists having a much more oval face, and greater temporal breadth. The common composite, as well as the others, had a far more youthful appearance than any of the pictures from which they were taken: only four or five at all approached them in this respect. Messrs. Peirce and Jastrow's experiments on the question, whether there is such a thing as a minimum perceptible difference of sensation, or what the Germans call *differenzschwelle*, were interesting. The experimenter arranged for the production, by an assistant, of successive differences of pressure upon the surface of his own body, so slight that he was unable, so far as he himself could judge, to either hear, or see, or even feel them; but actually, in the majority of cases, determined correctly whether the change was positive or negative.

Of purely zoölogical papers there were few. A paper by Professor Verrill gave an account of the present season's work of the U. S. fish-commission, which, by the steamer Albatross, continues to bring from the deep sea additional forms of animal life new to science, and in great numbers. The most unexpected result is the finding, in some of the deepest dredgings, of large masses of exceedingly compact clay, instead of the usual globigerina and other ooze. Dr. Packard showed, that, in a blind isopod crustacean from the Mammoth Cave, the brain differed from its allies only in that traces of the pigment-layers of the eye remained more or less developed after the entire abortion of the optic lobes and nerve. Professor Cope believed he had found the probable ancestors of the Mammalia in the Pelycosauria, — an extinct type of reptiles, which, of all reptilian types, shows at once the most distinct batrachian and mammalian features.

Major Powell gave a succinct account of the operations of the U. S. geological survey, exhibiting two copies of the land-office map of the country, — one colored to show the regions which had been occupied; the other, the broader features of its geology. Mr. Pumpelly gave a similar account of the work of the recently closed Northern transcontinental survey, and a special notice of the mesozoic coals met with in that survey. By the study of transverse and cross sections of the crystalline tufa of Nevada, Prof. E. S. Dana was able to determine that the original form of thinolite was a steep pyramid: it was probably a chloro-carbonate of calcium, now altered to calcium carbonate. Professor Brewer stated that in the dry regions of the west, especially when several dry seasons followed a succession of moister ones, in which the lands were overstocked, the nutritious grasses were eaten to death by cattle, and thereupon supplanted by noxious types. Several were mentioned as producing a rapid obliteration of our native pastures, and their seeds as injurious by piercing the skin, and producing sores.

Two reports called for by the government had been transmitted to the president of the academy, and will form a part of his annual report to congress, — one upon the organization of the scientific bureaus of the government, called for by the commission, whose appointment we noticed in the first number of this volume; the other upon the proper classification of philosophical instruments under the existing tariff regulations, called for by the secretary of the treasury. A second quarto volume of memoirs was announced as in the hands of the binder.

The next session of the academy will be its annual meeting, next May, in Washington.

DEATH AND INDIVIDUALITY.

The current conceptions of death as a biological phenomenon are very confused and unscientific. In this essay I shall endeavor to analyze the problem, and, by placing the factors concerned in a clearer light, to diminish the obscurity in which the subject is still involved. This appears to me the more desirable, because the recent publications of Weismann and Goette upon this general topic have increased rather than lessened the existing confusion. In fact, these authors fail to make the necessary distinctions between the different kinds of death, the different orders of individuality, and the different forms of reproduction. This assertion is, I believe, justified by the following paragraphs: —

First, as regards individuality. Individuality, as it is generally understood (i.e., as something always equivalent to itself), does not exist in nature, except subjectively as a rather fantastic notion of the human mind. The term 'individual' is applied to things utterly incommensurate with one another. An individual protozoon, an individual polyp, and an individual insect, are not homologous and comparable bodies. It is mere slavery to a false form of speech to imagine that their 'individuality' is a common quality; for, on the contrary, the same word indicates here three distinct phases. I know not how to account for the immense significance attributed to the mystical idea of individuality, which in reality corresponds only to a physiological capacity for a separate existence, but in usage is tacitly assumed to be the name of some vague fundamental property of life, which, however, the mind cannot apprehend. Now, we have renounced considering a wing in a bee, a bird, or a bat, as identical or homologous with every wing, either on account of its name or its function. But, although the different kinds of individuals of animals and plants are much more unlike one another than are the manifold types of wings, yet individuality is generally taken to mean a uniformly identical something; and that is untrue. Of course, the matter is really very simple, and indeed self-evident, as to its true nature; and the singular obscurity prevailing is probably due only to the problem not having been clearly thought over. At present the condition of opinion upon the subject reminds one of the ancient notions of beauty, according to which, beauty was an inherent quality of objects, not an impression of the mind, a psychological state. Despite custom, it is plain that 'individual' has many meanings; yet it is usual to compare 'individuals' with one another throughout the animal kingdom. This error has been repeated by Weismann and Goette, because they both assume that the death of a single protozoon is equivalent to the death of one of the higher animals. Goette, however, has partially emancipated himself from this idea, which I believe to be erroneous. The death of a unicellular, is entirely different from the death of a multicellular, individual.

To Huxley[1] we owe the first scientific determination of individuality. His essay on the subject ought to be thoroughly studied by every biologist. Life occurs in cycles of cells; *each cycle comprises all the cells springing from a single impregnated ovum;* the whole of every cycle is homologous with every other whole cycle, no matter whether every cell is a so-called individual, or whether they constitute several individuals (e.g., polyps) or a single one (vertebrates). *All cells are homologous, all cycles are homologous; but individuals are not always homologous*, since an individual may be either the whole or any fractional part of a cycle. This question I have discussed a little more fully on pp. 191, 192, of my article cited in the footnote.[2] Manifestly the death of the single cell is not necessarily identical with the termination of a cycle. Now, when a man, he being a cycle of cells, has lost the ability to continue the cycle, he (or it) dies. Further, it is inherent in his constitution to lose that ability gradually: hence, when it is completely lost from internal causes, he dies, as we say, from old age. It is to this ending-off of the cycle, from causes resident in itself, I wish to restrict the term 'natural death.'

We have now two questions to pose: 1°. Do all organisms belong to cell-cycles? 2°. If so, are all cycles self-limited? In common language, the second question would be, Is death always the natural and inevitable accompaniment of life? — an inquiry which may appear singular, but is none the less perfectly sensible and legitimate. Weismann has answered it with a negative.

1°. I maintain the hypothesis that all organisms do develop in cycles, and only in cycles; which involves the assumption that all living species begin their life-history with an impregnated ovum or its equivalent. We come, therefore, at once to the question of

[1] T. H. Huxley (1852) upon animal individuality, *Royal inst. proc.*, i. 184-189; *Edinb. new phil. journ.*, liii. 172-177; *Ann. mag. nat. hist.*, 1852.

[2] C. S. Minot (1879), Growth as a function of cells, *Proc. Boston soc. nat. hist.*, xx. 190-201.

how far sexual reproduction extends downward in the scale of life. I deem it very probable that it extends to the lowest animated being, even though it be quite differently manifested in the lower forms from what we observe in ordinary bi-sexual reproduction. This view is opposed to the opinions generally held: for botanists trace the evolution of sex within the vegetable kingdom; and zoölogists trace it, though less definitely, within the animal kingdom. We are thus forced to assume that sex, one of the most fundamental and characteristic phenomena of life, has arisen twice. This is to the last degree improbable. Such a coincidence would be the most extraordinary result of chance within human experience. It is more reasonable to suppose, that, though we do not yet recognize it, the sexual function exists in the protobionts, which are neither animal nor vegetable, and that they also produce a body homologous with an impregnated ovum; and to suppose, further, that, out of this common commencement, both animal and vegetable sex have been evolved. The essential property of the sexually produced ovum is its power of repeated division, producing a succession of cell-generations, which, together with the original body (*ovum*), constitute the cycle. There is much evidence of a positive character to confirm the belief of the cyclical course of life, even among the protozoa and protophytes, in which there occurs what is known as rejuvenation (*verjüngung*).

2°. I maintain that it is probable that all cycles of cells are self-limited. Let us first ascertain the nature of the limitation. Our knowledge of the manner in which the cycles are limited (i.e., of the causes of natural death) is very restricted, and derived solely from the higher animals. My own special investigations have been in this field, and have led me to the opinions and problems we are discussing.

My experiments demonstrate, that, when properly analyzed, the growth of at least the higher animals gradually diminishes from birth onwards, almost without interruption. This is an irrefutable mathematical verification of the views which I advanced in my article on 'Growth as a function of cells,' published in 1879, the essence of which, as far as we are now concerned, is, that the cells of a cycle continuously lose their power of division, so that the interval between two successive divisions gradually increases. This involves the ultimate termination of the cycle, because the losses go on, not only until the cells can no longer divide, but until they exhaust themselves. This whole series of changes is properly *senescence*, or growing old. Senescence is a continuous process, covering the whole period of a cycle of cells; and we must assume it is the positive loss of power in the single cells, such that the last-produced cells cannot continue, and *natural death* ensues. Of course, in the cases of a multicellular animal, death of the whole follows secondarily upon exhaustion of any essential part; as in the case of insects, which die upon laying their eggs. In the higher animals, then, the cycle is limited by senescence, and senescence is a decay which probably begins when the cycle begins. The next point to decide is, whether the same phenomenon occurs with the unicellular organisms. If it is found that the divisions of a Paramecium,[1] for instance, after a conjugation, are at first rapid, and then follow at increasing intervals, it would prove (provided, always, the external conditions remained constant) that we here had true senescence, with its sequel, natural death, or the end of the cycle. Until this point is settled, we cannot know whether there is, among unicellular animals, a form of death homologous with the natural death from senescence in the higher animals and plants.

It is to be regretted that both Weismann and Goette appear not to know the article to which reference has just been made: otherwise they would have recognized that the problem of death is, *first*, whether growing old (*veraltung*, *involution*) is a universal phenomenon of life. Weismann's first article was an address delivered before the German naturforscherversammlung, September, 1881, and subsequently republished at Jena.[2] He advanced then the view, that, for unicellular organisms, there is no death except through accident; that, the propagation being by simple division, we must assume that the process of division may go on forever. He does not even consider whether the cells form cycles, and whether these cycles need to be renewed; so that he misses the real problem. On the contrary, he is enchained a prisoner to the mystical idea of individuality, and reasons as if individuality rendered direct comparisons legitimate between things essentially different. All his reasoning is based upon the idea that an individual protozoan is comparable to an individual dog, and so on. The argument just made against him was to show that the basis of his whole fabric is illusory. Bütschli, in his short article,[1] called forth

[1] Paramecium is a common unicellular animal.

[2] Weismann, Ueber die dauer des lebens (Jena, 1882, 8°), 94 p. Cf. also Weismann's comments on Bütschli, *Zool. anzeiger*, v. 377–380, and his reply to Goette, — Ueber leben und tod (Jena, 1884, 8°).

by Weismann's, partially liberates himself from the confusion as to individuality, and propounds the hypothesis of a *lebensferment*, which he supposes to be continually renewed in protozoa, which he thus assumes to be potentially immortal. He also fails to recognize that the true question is, not whether single protozoa die, but whether they form senescent cycles. In this error he is followed by Cholodowsky,[2] who also admits that natural death is restricted to the multicellular animals, but overlooks what would be its only possible homologue among protozoa.

Goette seems to me to have made a distinct advance beyond his predecessors, for he has attempted[3] to show that there is a death common to all organisms. Especially is his conclusion that death and reproduction are intimately connected to be noted as important; but his thought appears to me often vague and obscure, and to many of his views I can by no means assent. I have just asserted that death and reproduction are intimately connected. Now, if my theory is correct, it is evident that each cycle, before it is completely exhausted, must produce the initials of new cycles: hence the connection in time between maturity, or the approach of death, and sexual reproduction. By speculation upon the few available facts, I have reached the following hypothesis. Originally each cell of a cycle was a distinct individual; the exhaustion of the last cells of the cycle *caused* them to become sexual bodies and to conjugate; conjugation renews the power of division in the conjugated individuals, and therewith a new cycle is begun. Subsequently multicellular animals were evolved, and in these the same phenomena recur; but some of the cells have become specially organized, and thereby incapable of assuming the sexual state: hence, when the end of the cycle approaches, only a few cells become sexual, and the animal (or plant) is mature. The higher organisms become sexually active only after having grown for a considerable period, because they still preserve the primitive relation. Senility is the *auslösende reiz* of sexual reproduction. I hope to discuss the matter fully in a memoir which I am now preparing for the press.

It is evident, that, according to this hypothesis, sexual reproduction depends on the exhaustion of the cells. There are many facts known to confirm this view. Thus among men the reproductive period begins sooner when they are ill fed. Among many of the lower plants, reproduction is induced by defective nutrition. I believe that nutrition and reproduction are, indeed, opposed to one another, but by no means in the sense taken by Carpenter[1] and Spencer.[2] While I consider that the impaired nutrition causes the effort to reproduce, they believe that reproduction is opposed to nutrition, constituting a tax which withdraws just so much from the parent. Undoubtedly, in those cases where the parent, in consequence of a secondary addition to the office of genesis, has to supply food to its young, reproduction may detract from growth, but, even in such cases, only sometimes. Carpenter and Spencer's whole argument rests upon the assumption that the power of assimilation is only just equal, or about equal, to the demands of the parent. It is, however, perfectly well known that the reverse is true, and that there is in most organisms a large surplus of assimilation possible, which is used whenever the functions demand it: hence in most cases the secondary taxes of reproduction can be wholly or mainly paid without calling on the growth capital of the parent. Spencer's *a priori* argumentation I consider superficial: it has led him to an exaggerated idea of an opposition which exists in nature, but is not general. Moreover, Spencer has mistaken the cart for the horse: animals do not stop growing because they begin to reproduce, but they begin to reproduce because they stop growing; or, more strictly speaking, both events are due to one cause, — senescence.

It will be seen, upon reviewing the preceding paragraphs, that the views I advocate are opposed to all the other opinions upon the nature of death which have been noticed above. In a memoir I am now at work upon, I hope to array a large number of observations to defend the theory outlined in this essay.

C. S. Minot.

[1] O. Biltschli (1882), Gedanken ueber leben und tod, *Zool. anzeiger*, v. 64–67.

[2] N. Cholodowsky (1882), Tod und unsterblichkeit in der thierwelt, *Zool. anzeiger*, v. 264, 265.

[3] A. Goette (1883), Ueber den ursprung des todes (Hamburg and Leipzig, 1883, 8°), p. 91.

AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION.

The wire dredge-rope.

It was a revolution in deep-sea dredging methods, when the cumbersome hempen rope was discarded for one of wire, measuring scarcely more than one-third the same diameter, stronger, more durable, and less expensive. The introduction of wire-rope will not affect

[1] William B. Carpenter, Principles of physiology, general and comparative (3d ed., 1851), p. 592.

[2] H. Spencer, The principles of biology, vol. ii. pt. vi.

the interests of the small-boat dredger; nor can this material be used to advantage without the aid of steam, but the active competition now existing with regard to deep-sea explorations must needs render its adoption necessary by all large expeditions.

Hemp rope was employed in all deep-sea dredgings up to the winter of 1877–78. One of the most serious objections to its use is the amount of space it occupies, especially when, as in the case of the Challenger, twenty-five thousand fathoms are carried. On the Porcupine, only three thousand fathoms of two-and-a-half and two-inch rope, weighing about fifty-five hundred pounds, were supplied; but for the convenient storage and handling of this there was required a row of twenty great iron pins, about two-and-a-half feet in length, projecting over one side of the quarter-deck from the top of the bulwark.

But a far greater objection to hemp-rope is the length of time required in making a deep-sea dredging with it, as experienced by Sir Wyville Thomson, and all other deep-sea dredgers prior to the past few years. In 1869 the Porcupine dredged in the Bay of Biscay, in a depth of 2,435 fathoms, requiring some ten hours for one haul. On the Challenger an entire day would be consumed in dredging or trawling in depths of from two thousand to twenty-five hundred fathoms.

For the utilization of steel-wire rope for deep-sea dredging, we are indebted to the fortunate suggestion of Professor Alexander Agassiz, who first recommended its use; and to Commander Sigsbee, U.S.N., who practically demonstrated its superiority over all other kinds of dredging-rope, and perfected the method of handling it. The first trials were made on the coast-survey steamer Blake, dredging in the Gulf of Mexico, in the winter of 1877–78. The size of rope then selected, and since employed by both the coast survey and fish commission, measures only $1\frac{1}{8}$ inches[1] in circumference, and has an ultimate strength of 8,750 lbs. The chief advantages of wire rope, in the words of Mr. Sigsbee, are "compactness, strength, durability, neatness, facility of handling with a small force, celerity of operations, and economy." The entire amount required to make the deepest dredging can be stored upon a single drum which occupies but an inconspicuous position on the deck. But few men are required for the operations of dredging; and the reeling-in can be performed, in case of necessity, by two men only, one standing at the hoisting-engine, the other at the reel.

Where the dredgings are confined to depths less than a thousand fathoms, as was the case with the steamer Fish Hawk, the hoisting-engine may be dispensed with, and the rope led directly to the reel, which can be made sufficiently strong to withstand the strain put upon it in using so small a quantity of rope. With operations simplified to this extent, a single man can control both the lowering and the reeling-in; the additional help being required only to handle the dredging apparatus on the deck, and to start it on its downward passage.

As to economy of time, the wire rope has a decided advantage over hemp or manila. Sir Wyville Thomson states that

"There can be no doubt that in any future expedition, on whatever scale, it would be an unjustifiable waste of time and space to neglect the use of wire for sounding, and wire rope for dredging and trawling; but it seems to me that even the use of these should be simplified, and not made more complex."

FIG. 1. — COMPARATIVE SIZE OF DREDGE-ROPES.
(*From Sigsbee's 'Deep-sea sounding.'*)

Prof. H. N. Moseley has been even more generous in his acknowledgments; and in a lecture on deep-sea dredging, delivered before the Royal institution of London in 1880, and published in *Nature* for April 8 of the same year, he spoke of the advantages of wire rope, which have already been alluded to.

Accessories to wire rope.

Among the important accessories to the use of wire dredge-rope, which have been introduced in this country, may be mentioned an improved form of accumulator, a set of safety-hooks for attaching the trawls, and several patterns of dredging-blocks.

The Sigsbee accumulator (fig. 3), which replaces the pattern formerly employed by the English, and which has since been adopted on the French steamer Talisman, was first used

[1] One of $1\frac{1}{16}$ inches has also been successfully tried.

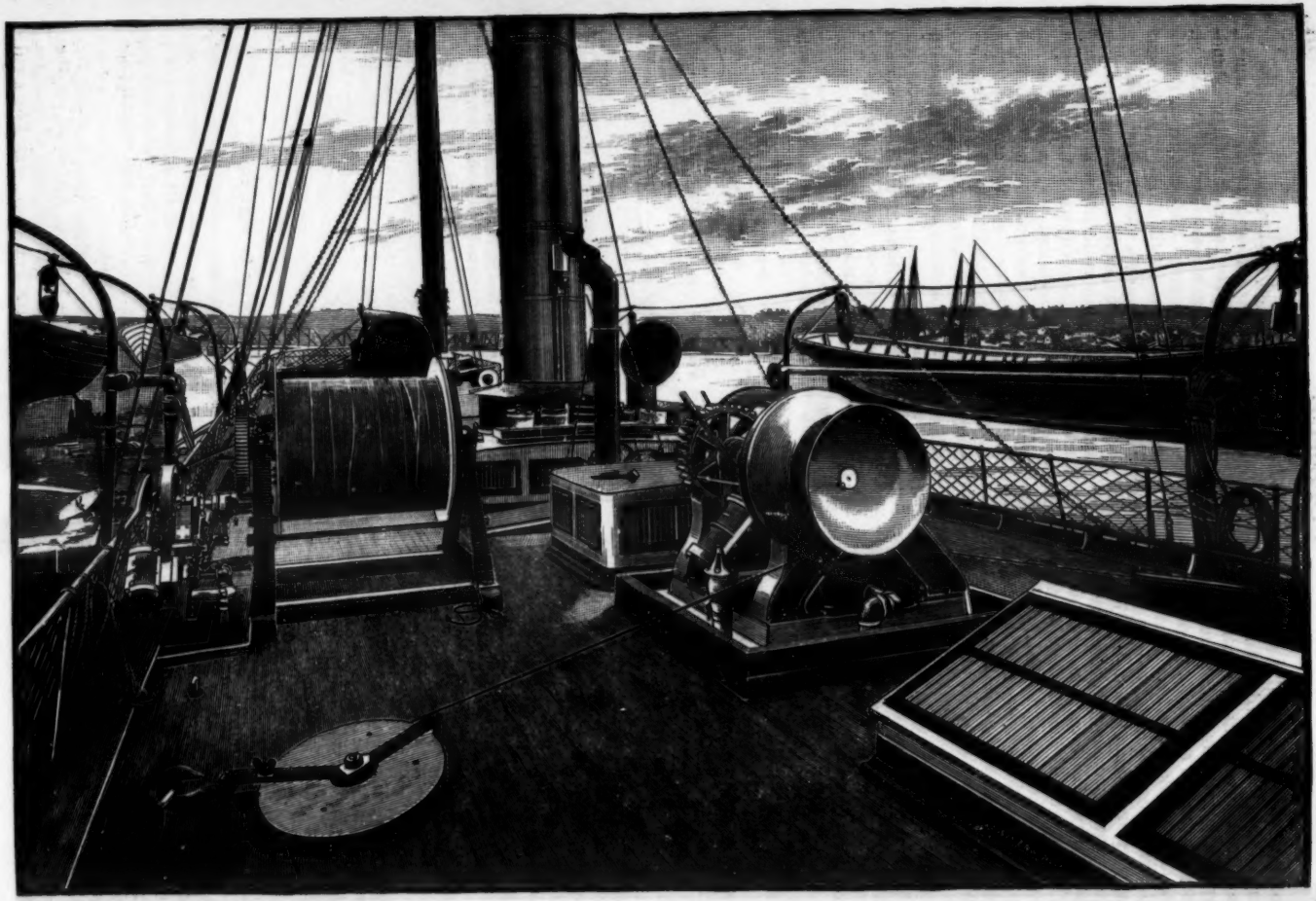

FIG. 2.—VIEW OF THE DECK OF THE BLAKE, READY FOR DREDGING.
(From Bigelow's 'Deep-sea sounding.')

on the steamer Blake, in 1878. It consists of a number (26 to 37) of rubber car-buffers, arranged for compression on a central rod, and separated from one another by thin brass guide plates provided with hubs or fillets, which prevent the buffers from coming in contact with the rod. Under strain applied at the lower end, the accumulator elongates, and when released from strain is restored to its former length by the elasticity of the buffers. The

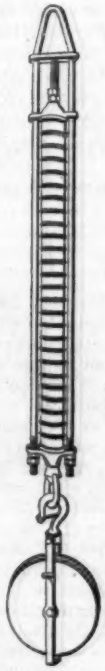

FIG. 3. — SIGSBEE'S ACCUMULATOR FOR DEEP-SEA DREDGING, WITH DREDGE-BLOCK ATTACHED.

FIG. 4. — THE SAFETY-HOOKS FOR ATTACHING THE BEAM-TRAWL TO THE DRAG-ROPE. SHOWN IN DETAIL.

amount of extension afforded by the Blake's accumulator was six feet, which, according to the experience of Commander Sigsbee, is quite sufficient; the principal purpose of an accumulator being to indicate the amount of strain after fouling, and when the dredge-rope has been hauled tight and is nearly vertical. The English accumulator, consisting of a number of long elastic rods, was intended to relieve the first strain upon the rope in case of fouling.

The safety-hooks (fig. 4) invented by Capt. Tanner, U.S.N., are an ingenious device for releasing the beam-trawl in case of its fouling irretrievably, and thus relieving the strain upon the rope which might otherwise break at some distance above the bottom, thereby entailing an additional loss of rope. They consist of a stout steel spring enclosed in an iron cylinder, and controlling the opening and closing of a pair of heavy iron hooks, which project from one end, and can be adjusted to detach at any point between three thousand and six thousand pounds.

Commander Sigsbee first improved the dredging-blocks. In the deck-blocks, the side plates are free to revolve; but in that which hangs pendent from the boom end, they are pinned to the strap, and connected by socket-bolts, which are intended to prevent the dredge-rope from getting between the side plates and the strap. The dredging-blocks supplied to the Albatross have no side plates; and the sheave, which is of brass, revolves on a series of brass friction-rods surrounding the steel pin or axis.

Sieves.

Convenient sieves for working over the mixed materials after they have been landed upon the deck are very important adjuncts to the dredging work.

The larger proportion of the contents of the dredge and trawl frequently consists of mud or sand, which requires to be washed from the specimens before they can be preserved or studied. Many different devices to accomplish this sifting or washing have been tried, both in this country and in Europe: but of those now employed by the Fish-commission, only one has been borrowed; the others, two in number, having originated with this survey. The three patterns of sieves are intended for different purposes. The simplest is a nest of circular sieves similar to those figured in Sir Wyville Thomson's 'Depths of the sea,' and used for sifting small quantities of material by hand, in a bucket or tub of water.

The rocker or cradle sieve (fig. 5) is designed especially for washing the contents of the dredges; and the table sieves, for the great mass of material which so often comes up in the trawl; but the latter has been found so useful for all kinds of work that it is now most commonly employed, especially as it forms in itself a large and convenient sorting-table around which a number of persons can stand at a time. The cradle sieve was devised by Professor Verrill in 1872, to afford the means of rapid washing over the side of the vessel. It is semicylindrical in shape, the curved bottom and sides consisting of two thicknesses of

FIG. 2. — VIEW OF THE DECK OF THE BLAKE, READY FOR DREDGING. (From Agassiz's 'Deep-sea soundings.')

wire netting; the lower having a strong and coarse mesh, and designed to give strength to the upper netting which determines the size of material which can be washed through. The end pieces are of wood. A rectangular box fitting into the top of this sieve, and having a coarse wire bottom, is sometimes employed for the purpose described below in the next pattern. The table sieve was the joint invention of Professor Verrill and Capt. Chester in 1877, and was originally intended to receive the contents of the trawl which had been previously dumped upon the deck. It consists of a large rectangular wooden frame, supported upon legs of a convenient height, and with a bottom of heavy galvanized wire-netting which serves to support the real bottom of the sieve. This is of fine wire-netting fitted to a removable frame. Above this is a second, hopper-shaped frame-work, covered underneath with

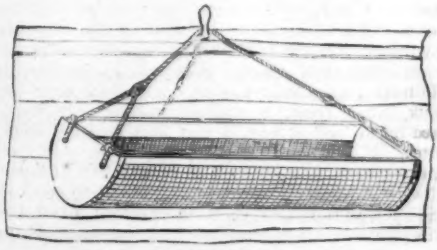

Fig. 5.—Verrill's cradle sieve.

coarse netting, and provided at about the middle of the side with cleats which rest upon the upper edges of the main frame when the three frames are nested together for use. The trawls are emptied into the hopper frame, which retains the coarser objects, allowing the smaller and generally more delicate specimens to be washed out on to the finer netting below. This arrangement of sieves has been found to give greater satisfaction than any other for washing large quantities of material, and keeps the specimens in better condition. The under part of the main frame is covered with heavy canvas, which serves to direct the water to the canvas tube in the centre, and thence over the side of the vessel.

Mr. James E. Benedict, naturalist on the steamer Albatross, has recently added an interesting feature to this sieve, for collecting and cleaning the foraminifera taken in the trawls, and of which many quarts were frequently washed away and lost by the old method at every haul. The canvas tube is simply arranged to lead into the side of a cask placed close to the sieve, and from which the water escapes at a slightly higher level on the opposite side. The heavier particles carried through the tube by the great force of the current are thereby given a chance to settle in the cask; the lighter sediment, composed mostly of fine mud, passing off through the outlet. After the washing has been accomplished, the water remaining in the barrel is decanted or drawn off through a siphon. The washing, in both the cradle and table sieves, is accomplished by means of a stream of water supplied through a hose. The large sieve figured on the deck of the French steamer Talisman in a recent number of *La nature* (see *Science*, vol. iii. p. 453) appears to partake of the character of the table sieve above described, although its details are not shown.

Richard Rathbun.

KAFIRISTAN.

The adventurous journey of Macnair, disguised as a native physician, into Kafiristan has given us the first testimony of a European eye-witness to the characteristics of that country and its inhabitants. Without recounting the itinerary, or specially detailing the perils of the traveller, which were not few, it may be mentioned that a part of his route lying between Mirga and Lowerai Kotal was at an altitude of 10,450 feet above the sea-level, winding through the snow between heaps of stones, which cover the remains of Mohammedans assassinated by the Kafirs. Elphinstone relates, in his 'History of Kabul,' that, on the occasion of a sacrifice, the prayer offered was, "Defend us from fever, increase our wealth, kill the Mussulmans, and after our death admit us to Paradise." It appears that none of their religious duties are better attended to by the Kafirs than that of killing the Mussulmans. Much the same importance is attached to it as belonged to head-hunting among the Dyaks, and no young Kafir is allowed to marry until he has killed at least one. A very similar feeling would seem to exist towards Europeans.

Kafiristan embraces an area of some five thousand square miles, limited to the north by the stupendous crest of the Hindu Kush, of which at least one peak rises above twenty-five thousand feet; on the south by the Kunar range; and on the east and west chiefly by the Alishang and Kunar rivers. Three distinct tribes — the Ramgals, Vaigals, and Bashgals — correspond to and occupy the three principal valleys of the country, the last being subdivided into five clans. The Vaigals are reputed to be the most numerous, and occupy the largest valley. Each tribe has a distinct dialect, but all have many words in common. In general, the three tribes have few relations with each other. Altogether, they are supposed to number about two hundred thousand people.

The country is wild, picturesque, and densely wooded. The men are fine-looking. Blue eyes are rare, but brown ones, and light, or even reddish hair, are common. The complexion varies from a ruddy blond to a bronze color, which is, doubtless, partly due to exposure. Their stature is but moderate. The men are fearless but lazy, and leave the work of agriculture to the women. When not at war they hunt. They are devoted to the dance, with which they occupy most of their evenings. The dance in use is invariably initiated by a woman, who goes through a prelude of graceful posturing. At a given signal, the dancers take their places on either side of the fire; the musicians, with a drum, flutes, and cymbals, taking a place at the end of the lines. At a second signal, couples form, and later turn singly around the fire. The dance terminates by a new formation of couples, holding a stick between them, feet firmly planted and close together, when they turn with great rapidity, first from right to left, and then in the reverse direction.

The houses are constructed on the mountain-side. The ground-floor is of stone, ten or twelve feet high, and is not used, except for storing wood and dry dung, both used for fuel, the latter especially in the preparation of cheese, which is made daily, and is of good quality. Above the stone foundation the structure is entirely of wood, with a sort of gallery around it. There are but two rooms, clean but very dark. The door-jambs are rudely carved. There is little furniture, but chairs of wood or wicker are in general use. The ordinary food is composed of bread and cheese in a sort of sandwich, dipped in melted butter, and boiled meat. The beds are built like a bunk attached to the wall. Some houses are provided with two stories, both of similar construction. The roof is made of flat stones, covered with a coating of clay.

The temples comprise a single square room, in which there are some large water-worn stones taken from the bed of the river, but no idols, except certain figures used in the funeral ceremonies be so considered. The dead are taken in their coffins into the temple, where sacrifices are made, and the remains then carried to the appointed place in the cemetery, but they are not buried. As to religion, the Kafiri believe in a passive supreme being, and a very active devil to whom all mischances are ascribed.

The men shave the head, except a single long lock on the summit, and go uncovered. Their dress is much like that of the Afghans, chiefly of cotton, with leather buskins made of laced strips of hide. The women wear the hair long, coiled under a large bonnet, through the top of which two tufts of hair project, looking at a distance like horns. Slavery is practised. Polygamy is exceptional. The unfaithful wife is beaten, and her lover fined not less than six head of cattle, and more according to his means. They have been supposed to be great wine-bibbers; but Mr. Macnair found in use only grape-juice, neither fermented nor distilled. This is pressed out during the vintage, and kept in jars under ground until needed. They are armed with the bow and arrow and a few matchlocks. The traveller observed artificial ponds, made to entice the wild ducks who pass over in their annual migrations. Some of the rivers carry gold; but the chiefs oppose washing for it, having in view the inevitable consequences to which successful gold-mining would give rise.

The people are intensely jealous of European invasion. The mere suspicion of European origin several times put the life of Mr. Macnair in serious danger, and intended journeying in several directions was given up as unsafe on this account.

THE CHANGES WHICH FERMENTATION PRODUCES IN MILK.[1]

MILK, if left standing a short time, becomes a sort of acidulated jelly called curd. In cheese-making this transformation is hastened by bruising; but in both cases the acidity and the peculiar savor of the curdled milk are caused by a microbe, the lactic bacillus, whose little rods are swimming by millions in the turning liquid. Only the caseine, the albuminous portion of milk, which forms the principal ingredient of cheese, coagulates: the lactic bacillus, recently studied by Mr. Hueppe, avoids this, and prefers the sugar of the milk, which it changes into a lactic acid. Without the bacillus, the milk would not sour. If milk, when fresh, is carefully poured into sterilized flasks, and corked, it may be preserved indefinitely. Repeated warmings have the same effect; but the operation is too delicate to be of practical value. If we touch curdled milk with the point of a pin, and then plunge the point into fresh milk, in a few hours this milk will also be curdled. This pin-point carries the lactic bacilli in sufficient quantities to sow any quantity whatever of the milk-food. By introducing other microbes, milk will undergo a number of dissimilar transformations, according to the germs which are sown in it. The germs of the butyric bacillus condense the milk without its becoming acidulated: on the contrary, it will have an alkaline reaction, with a bitter taste, and an odor resembling that of fresh cheese or whey. By adding a little blue milk, in a few hours the whole becomes blue. The milk neither curdles nor sours, but a drop examined under the microscope is seen to swarm with vibrios. This is the cyanogen bacillus; and when sown in glue, in potato, or in soup, it everywhere multiplies, and makes the substance blue. At times this bacillus causes an eruption, which is cured with much difficulty. Milk is not rendered unwholesome by it, nor disagreeable in taste; but it is blue, which does not increase its market-value. A little ropy milk added will in three days make milk so thick that we can invert a bottle containing it without losing a single drop. In this case a peculiar microbe, a micrococcus, has been at work. This has been described by Mr. Schmidt-Mulheim, who deserves a place of honor among confectioners; for he has discovered a method of producing

[1] Abridged from an article by Dr. H. FOL, in the *Journal de Genève*.

a substance much resembling gum tragacanth, which, when added to the jelly, makes it harden. This milk-jelly is easily digested, its taste is perfect, and it may be preserved, even in the air, for ten days. The inhabitants of the north of Sweden preserve the precious microbe, caring for it as the savages care for their fire. They put it in all the milk they wish to preserve, as such milk is better and more easily obtained, in every case, than the condensed milk of the factories of Cham and Montreux. Alcoholic fermentation is produced in milk when sown with koumiss, or with the fungus of kéfir, a favorite Russian drink. This curious ferment is a combination of two distinct ferments, — a yeast analogous to that of wine, and a microbe, Dispora caucasia. These two organisms live together in perfect harmony, and for a common end, — the production of a gaseous, piquant, agreeable, and, above all, healthful beverage. The kéfir is especially valuable as a food for infants and invalids. Several physicians of Geneva intend to make trials of it, and we are in hope of being soon enriched by the addition of a new and valuable hygienic food.

THE MERIDIAN CONFERENCE.[1]

AT Tuesday's meeting, Oct. 14, the resolution to reckon longitudes east and west from Greenwich to plus and minus 180° was advocated by Professor Adams, Capt. Evans, and Gen. Strachey, of Great Britain, and by Mr. Rutherford; the very strong point being urged in its favor, that the jump in longitude from + 180° to − 180° occurs in the Pacific Ocean, where the local time now jumps twenty-four hours, — and it must do this somewhere, — and hence it will cause no change from the present practice among navigators, or in the date of the present local time of any part of the earth; and the relation between the local date and hour of any place, and the universal time of the Greenwich meridian, will always be correctly given by the simple formula, $L.T. = U.T. + \lambda$, λ being the longitude expressed as above. After a short recess for informal discussion, the resolution was adopted by a small majority.

A resolution was then introduced, that the conference propose the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local time where desirable.

The delegate from Italy offered as a substitute the resolution of the geodetic conference at Rome, which proposed a universal day of twenty-four hours, beginning at Greenwich, mean noon; i.e., the present astronomical day, twelve hours later than the civil.

Mr. Allen here read a paper upon the needs and conveniences of the railroads and telegraphs, advocating local times differing whole hours from each other, and introduced a resolution that local time be held to mean that of the nearest meridian situated some whole number of hours from Greenwich; but, after some discussion as to the competence of the conference to go so far into details, he withdrew it.

The resolution to adopt the recommendation of the Roman conference was lost, and the original resolution was adopted by a large majority.

It was then proposed that the universal day be a mean solar day, to begin for all the world at the moment of midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian, and to be counted from zero up to twenty-four hours.

To give time for informally considering this, and for the secretaries to revise and publish in English and French the two-days' proceedings, the conference adjourned till Monday, the 20th.

At the meeting on Monday, the delegate from Spain proposed the adoption of a universal day corresponding to the local day of Rome, 'on account of classic historical associations,' and apparently with the idea that somehow the epoch of the Gregorian calendar would be changed by adopting the Greenwich day.

Professor Adams and Commander Sampson pointed out the confusion that would arise from reckoning time from one meridian, and longitude from another; and, after further discussion, all the amendments were voted down, and the original resolution, recommending a universal day beginning at midnight of the prime meridian, and counted from zero to twenty-four hours, was adopted by a considerable majority. Another resolution was passed by a large majority, expressing the hope of the conference that the astronomical and nautical days may soon be arranged everywhere to begin at midnight.

Mr. Janssen introduced a resolution expressing the hope of the conference that all nations will make a study of the advantages of dividing the day and circular measure, wherever used, into four quadrants, with decimal division of quadrant. After considerable discussion, this was adopted with a slight modification in the phraseology.

Gen. Strachey offered a resolution recommending that all local times differ, by some multiple of ten minutes, from that of the prime meridian. Without acting on this, the conference adjourned till Wednesday.

[1] Continued from p. 378.

COTTERILL'S APPLIED MECHANICS.

Applied mechanics: an elementary general introduction to the theory of structures and machines. By JAMES H. COTTERILL. London, *Macmillan*, 1884. 20 + 584 p. 8°.

THE appearance of a new book by the distinguished lecturer on applied mechanics at the Royal naval college, the organization of which he has done so much to forward, and the prosperity and success of which are ascribed so largely to Professor Cotterill, is an event likely to interest all who are engaged in similar lines of work. The opportunity is not open to the writer upon the subject of applied mechanics to produce as completely novel a work as was the earlier book by the same author, — 'The steam-engine considered as a heat-engine.'

The work is professedly based upon Rankine's treatise, and is supplemented by a large amount of other, and some new, matter. The plan of the work is in some respects unusual. Its first part is devoted to the statics of structures, the second to the kinematics of machines, the third to the dynamics of machines, the fourth to the strength and stiffness of materials, and the fifth to the transmission and conversion of energy by machines.

In part i. but little will be found to demand special notice. The methods of graphical statics are adopted throughout, and are applied in succession to the simplest and the more complex cases. The straining action of a load applied to a structure is considered in several chapters; shearing, bending, and twisting being taken up in order. Cases of frames having redundant parts, and the action of a travelling load, are given with propriety considerable space. In part ii. we find the author following Rankine in an innovation upon the standard plan of text-books on mechanics as hitherto constructed. Professor Cotterill here introduces the study of the kinematics of machines, — a subject not often considered to form a part of this general division of the theory of engineering, and only treated of, up to the present time, to any considerable extent, in separate works, as in Willis's and in Reuleaux's well-known works. Rankine introduced this subject, under the title 'Geometry of mechanism,' into his 'Machinery and mill-work,' and introduced it also in his 'Applied mechanics.' This author has introduced to a limited extent the nomenclature and methods of the latest of the great masters of this division of the science of engineering, Professor Reuleaux, and has thus brought the matter fully up to the time. A feature of the work to be noticed here, perhaps even more than elsewhere, is the selection of mechanism familiar to the engineer, and where possible of those in common use, in illustration of the principles to be explained. Part iii., on the dynamics of machinery, as would naturally be expected, occupies a large amount of space. It opens with a statement of the 'principle of work,' shows how resistances are determined in common cases, defines energy, illustrates the methods of its transfer in machines, and considers the kinetic form of energy as met with in freely-moving bodies and in machines. A chapter is devoted to the dynamics of the steam-engine, and especially to the graphical representation of the variation of effort and of energy at the crank. All of this work is interesting and valuable; and the greater part of it is here for the first time, so far as the writer is aware, introduced into the literature of the schools.

The study of cases of incomplete constraint and of straining actions in machines gives the author an opportunity to introduce the principle of momentum and other dynamical principles, and to illustrate their application by the analysis of the governors and other familiar cases. Part iv., on the strength of materials, occupies more space than any other division of the book. Impact, compound stresses, and flow are as fully treated as the limits of the book permit, and more so than is usual in treatises of this character. The work of Professor James Thomson on the flow of solids is described, and the experiments of Tresca and of Wohler are cited.

The volume includes in its last division, part v., a discussion of the principles involved in the transmission of energy by fluids, and of its transformation. The flow of fluids, the action of machines driven by them, and the elementary principles of thermodynamics, are here studied.

An excellent feature of the book is its references to works in which the subjects treated are more fully developed by accepted authorities. Examples are introduced at the end of each chapter which are doubly interesting as illustrating the special case there treated, and as exhibiting applications occurring in the engineer's practice. The engravings are numerous, and, in all cases in which it is possible, drawn from working machines and structures common in engineering.

The work as a whole is one which will not only increase the reputation of its author, but will earn for him the thanks of many instructors in technical schools who have long been hoping for such a treatise as will permit them to discard works, which, valuable in their day, are now left behind in the forward movement of the profession of engineering and of science.

SCIENTIFIC BUTTER-MAKING.

A manual for scientific butter-making. By W. H. LYNCH. Printed by order of the legislative assembly. Toronto, *Robinson pr.*, 1883. 15+ 204 p. 8°.

THE author, in the introduction to this manual, expresses himself in sympathy with the views advanced by Arnold and Bell on previous occasions, that all persons connected with the prosecution of the dairy business should strive to make themselves familiar with the principles on which success depends. These

considerations are, in his opinion, the key to the character of the manual.

Practice and theory are treated in separate chapters, beginning, for stated reasons, with a description of the most successful method of butter-making, and closing with an exposition of the philosophy of the various modes of operation. The discussion opens quite deservedly by dwelling on the importance of cleanliness as the first and indispensable requirement for success in the dairy industry. The first chapter treats of the best indorsed rules for milking, and for setting milk for cream. The setting of milk in open and closed vessels, as well as the proper conditions of the cream for churning, and the management of churning, are carefully discussed. The author very frequently cites well-known authorities in the dairy business — Professors Arnold and Lewis — in support of his statements. A detailed description of the best rules for collecting, washing, pressing, salting, packing, and marketing the butter, closes the first chapter on the scientific method or process.

The succeeding chapter explains the philosophy of the rules of treatment during the various stages of the process, which have been previously enumerated and critically discussed. The different points involved are here stated in an equally instructive manner. More prominence might have been given to a consideration of the chemical character of the various glycerides constituting the fat of milk, and consequently of the butter, as compared with those which constitute other animal fats. The serious influence of exceptionally large quantities of the glycerides of four volatile fatty acids on the successful manufacture and on the keeping of butter is quite manifest, and deserves more than a passing notice. The first part of the book closes with remarks on milk-production, on the natural functions of the cow, on breeding and feeding, on dairy utensils and supplies, on water and its uses in the dairy, and on salt and its proper application in butter-making. The discourse on these subjects occupies about forty pages of the manual.

It is unfortunate that by far the larger part of the pamphlet (the appendix) should be taken up with quotations from agricultural newspapers, and that in the closing paragraphs it should be stated that Mr. Lynch is the owner of the patents on the forms of butter-making appliances which he advocates. The work, with its numerous newspaper extracts and poor printing, has not the appetizing appearance so essential to a new book, and is calculated to repel one at the first glance.

MAN'S FUTURE.

The destiny of man, viewed in the light of his origin. By John Fiske. Boston, *Houghton, Mifflin, & Co*, 1884. 10+121 p 16°.

"The question of a future life is generally regarded as lying outside the range of scientific discussion," says the writer; but yet he thinks it is one upon which an opinion may be legitimately entertained, and he proceeds to say, that opinion "must necessarily be affected by the total mass of our opinions on the questions which [do] lie within the scope of scientific inquiry." His essay is to let us know what the teachings of the doctrine of evolution as to the origin of man seem to indicate as to his final destiny. His conclusion is, that "the more thoroughly we comprehend that process of evolution by which things have come to be what they are, the more we are likely to feel that to deny the everlasting persistence of the spiritual element in man is to rob the whole process of its meaning," and that it goes far toward putting us to 'permanent intellectual confusion;' which, as a well-known authority assures us, is a scientific *reductio ad absurdum*. So, finding "no sufficient reason for our accepting so dire an alternative," our author declares, "For my own part, therefore, I believe in the immortality of the soul, not in the sense in which I accept the demonstrable truths of science, but as a supreme act of faith in the reasonableness of God's work. . . . The belief can be most quickly defined by its negation, as the refusal to believe that this world is all." We must refer to the little book itself for the line of argument which leads up to this *credo*. And if the argument, however scientifically based, is philosophical and even theological in form, it needs only to be understood that this essay is, in fact, an address to the Concord school of philosophy last summer, at the time when the subject of immortality was under discussion.

NOTES AND NEWS.

The following is the full list of papers read at the Newport meeting of the National academy of sciences, Oct. 14–17: On the Columella auris of the Pelycosauria, E. D. Cope; The brain of Asellus, and the eyeless form of Cecidotaea, A. S. Packard; On the theory of atomic volumes, Wolcott Gibbs; On the complex inorganic acids, Wolcott Gibbs; Notice of Muybridge's experiments on the motions of animals by instantaneous photography, Fairman Rogers; Notice of Grant's difference-engine, Fairman Rogers; On the thinolite of Lake Lahontan, E. S. Dana; On the mesozoic coals of the north-west, R. Pumpelly;

On the work of the Northern transcontinental survey, R. Pumpelly; The grasses mechanically injurious to live-stock, William H. Brewer; On gravitation survey, C. S. Peirce; On minimum differences of sensibility, C. S. Peirce and (by invitation) J. Jastrow; Researches on Ptolemy's star-catalogue, C. H. F. Peters; On the operations of the U. S. geological survey, J. W. Powell; The motion of Hyperion, Asaph Hall; Remarks on the civilization of the native peoples of America (by invitation), E. B. Tylor; Some results of the exploration of the deep sea beneath the Gulf Stream, by the U. S. fish-commission steamer Albatross during the past summer, A. E. Verrill; Recent progress in explosives, H. L. Abbot; On an experimental composite photograph of the members of the academy, R. Pumpelly; Report on meridian-work at Carlsruhe (by invitation), W. Valentiner; On the algebra of logic, C. S. Peirce; On the temperature of the lunar surface, S. P. Langley; On methods of eastern archery, E. S. Morse.

— A letter to Lieut. Schwatka, from one of the officers of the Imperial geographical society of Russia, states that no polar expedition is to start from Russia this year or next, as has been widely circulated in the American press. There is in view, however, an expedition to the New-Siberian Islands, to start in the spring of 1886, to be carried on by money appropriated by the czar for that purpose. The expedition is to be undertaken by two gentlemen from the Imperial academy of sciences of St. Petersburg, and the preparations for it are going on under the supervision of a committee appointed by the academy. The year 1885 will be employed in scientific work on the Yana and the coast between it and Indigirka.

— Among recent deaths we note those of G. B. Delponte, formerly professor of botany in the university of Turin, well known for his researches upon the Desmidiae, on the 18th of May, at Mombaruzzo, Piedmont; Count Constantin Branicki, a zealous promoter of natural science, to whose generosity the museum at Warsaw is indebted for a large part of its valuable collections, July 14, at Paris; August Pasch, professor of mathematics at Stockholm, in that city, on the 16th of July; L. M. Larsson, author of 'Flora af Wermland,' on the 17th of July, at Carlstad, Sweden; Dr. M. Perty, a well-known zoölogist and anthropologist, from 1834 to 1875 professor of natural history in Berne, where he died Aug. 8, almost eighty years of age; in Moscow, the last of July, A. G. Fischer von Waldheim, president of the Moscow natural-history society; E. P. M. Fournier, botanist, in Paris; Lodovico Caldesi, botanist, July 2, in Faenza; Dr. E. Carstanjen, chemist, on the 13th of July, at Leipzig, in his forty-ninth year; Dr. Hans Hübner, the director of the chemical laboratory at Göttingen, on the 13th of July, in his forty-seventh year; and Dr. Ferd. Hochstetter, geologist and naturalist on the Novara expedition, on the 18th of July, in his fifty-sixth year.

— Prof. F. E. Nipher finds from data taken from Dr. Engelmann's observations at St. Louis, Mo., lasting over a period of forty-seven years, that the duration of maximum rains is inversely proportional to the violence, or that the product of violence into duration is constant. This constant is the amount of water which may fall in a continuous rain, and is, for Dr. Engelmann's series of about half a century, about five inches. A rain of five inches per hour may last one hour. A rain of four inches per hour may last an hour and a quarter; and such a rain Dr. Engelmann observed. A rain of two and a half inches per hour may last two hours, and several such rains were observed. A rain of an inch per hour may last five hours. Each of these cases would be a five-inch rain. For a longer period of time than fifty years it is likely that greater rains than five inches may be observed. The same is to be said if observations are to be taken over a wider area of country. In fact, a rain of six inches in three hours occurred near Cuba, Mo., some years since. This would increase the value of the constant from five to six, but otherwise the relation will probably remain unchanged.

The importance of this law is very great in engineering, where the capacity of sewers, culverts, and bridges, must be such as to carry the water. A more general investigation which Professor Nipher is now making will determine the relation between the violence, duration, and frequency not only of maximum, but of all rains. This work, when completed, will enable an engineer to construct the water-ways of bridges of such a capacity that they will probably stand a definite number of years before they are washed away. This number of years will be so determined that the interest on the invested capital during the probable life of the bridge will equal the possible damage when the destructive flood comes which the engineer determines shall destroy his work. The running expense of maintaining the bridge is then the least possible.

— A late number of the *Academy* states that the eleventh annual meeting of the German and Austrian alpenverein has just been held at Constanz, under the presidency of Herr Richter of Salzburg. The grand duke of Baden took part in the proceedings. The united clubs have a membership of 12,500, and the property of the verein amounts to 11,430 florins. Grants were voted for forest-planting, for support of certain mountain sections of the club, for payment of persons who have engaged to lecture during the winter months, for meteorological observations, and for explorations of caverns. Next January will be published the first collected volume of the *Mittheilungen* of the club, with illustrations. Collections of 3,130 marks and 9,925 florins were made for paths and huts. Villach was selected for next year's meeting.

— Signal-service note xvi., entitled 'The effect of wind-currents on rainfall,' by G. E. Curtis, is one of the most carefully prepared numbers of the series, both in the reference to previous work on the subject, in which English, French, and German authors are quoted, and in the discussion of the special series of records from five gauges on the summit of Mount Washington. The author concludes that the rainfall (without snow) in such exposed situations varies materially within distances of only one or two hundred

feet; that the windward gauges receive least and the leeward gauges most rain, as had been stated for buildings by Bache in 1837; and that, in high winds, small gauges do not collect enough rain, the discrepancy between eight-inch and three-inch gauges varying as the square of the wind's velocity; and, for velocities of sixty miles an hour, the three-inch receiving only two-thirds of the rain collected by the eight-inch gauge.

— The elasticity in the carbon filaments of the incandescent lamps, at least in some of the patterns, is rather remarkable. Take an Edison lamp of about a hundred ohms resistance, and a moderately sharp blow with the hand at right-angles to the plane of the loop will vibrate it so far that it strikes the side of the glass bulb; and it will continue for two minutes, swiftly vibrating through very slowly decreasing amplitudes, and with beautifully complicated nodal effects, according to the direction of the blow. So sensitively elastic are some of them, that it is difficult to hold them in the hand so steadily that the upper part of the loop is not blurred by rapid incessant vibrations of small amplitude.

— The Royal society of New South Wales offers its medal and a money-prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation, upon each of the following subjects. To be sent in not later than May 1, 1885: anatomy and life-history of the Echidna and Platypus, the society's medal and £25; anatomy and life-history of Mollusca peculiar to Australia, the society's medal and £25; the chemical composition of the products from the so-called kerosene shale of New South Wales, the society's medal and £25. To be sent in not later than May 1, 1886: on the chemistry of the Australian gums and resins, the society's medal and £25.

— The committee of the Octagon chapel at Bath, England, where Sir William Herschel was organist from 1766 to 1782, invites subscriptions toward a memorial-window of one whom they truly call 'by far the most distinguished citizen who ever lived in Bath.'

— The *Illustrirte zeitung* reports that the new torpedo-boat tried at the recent manœuvres of the German fleet has proved eminently satisfactory. In addition to its great strength and speed, it has water compartments which can be suddenly filled, and thus sink its deck to the level of the sea, without seriously impairing the speed of the vessel.

— The London health exhibition has been so successful, that it is expected the council will have a handsome balance when they close their doors; and they have not yet decided what to do with it. The aggregate of admissions now exceeds two millions and a half, representing a gross taking of a hundred and ten thousand pounds, ten per cent of which may remain when the last liability has been wiped off.

— Mr. Farini of the Royal aquarium, London, has now on view some of the dwarf race of men reported by several travellers as dwellers in equatorial Africa; and he has invited all anthropologists there to study this strange development of the human race. The tallest of them is four feet six inches in height, and professes to be a giant among his own people. They are exceedingly intelligent.

— The Social science congress this year met at the place of its origin, Birmingham, and attracted a much larger attendance than last year, the programme of work being a fine one. The president of the year, Mr. Shaw Lefevre, in his opening address, reviewed the reaction from the non-intervention views of state policy of Ricardo, Stuart Mill, Bastiat, etc., and stated his opinion that the present "movement for extending the action of the state has not been due only to democracy. It has been demanded almost equally by all classes; but the greater force of the popular will in parliament has deprived the opposing interest of their power of resistance. . . . The more recent school of political-economists in this country, and still more on the continent, has largely departed from these (earlier) views, and has held, that while free exchange, free labor, and free contract are important principles to maintain, yet the state is bound to interfere when individual interests result in the degradation and oppression of the lower classes, and that it is justified in undertaking those works and functions which can be better attained by it than by individual effort. Almost alone, my friend Mr. Herbert Spencer has been left among philosophers, to preach the doctrine of *laissez faire*, to raise the banner of individualism against state action, and to denounce what has been done during the last few years as radically wrong in principle, and leading to socialism, or to the ultimate slavery of the masses."

During the last ten years, he stated, taking the increase of population of England and Wales into account, there had been a decrease of pauperism of thirty per cent, and of serious crime of twenty-two per cent.

— Prof. W. Braune claims to have discovered some constant principles of arrangement of the veins in the human body, the variability of which has been an anatomical puzzle of long standing. He proposes to publish an atlas in imperial folio under the title '*Das venensystem des menschlichen körpers.*' The first part with four colored plates, prepared with the collaboration of Mr. E. Harry Fenwick, is now announced by Veit & Co. of Leipzig; price 45 Rmk.

— The Prussian authorities are planning a hygienic institute, as a branch of the University of Berlin, similar to the existing institutes of physiology, etc., this branch of knowledge being recognized as necessary to the medical profession. It is said that Dr. Koch will be placed at the head of it.

— Dr. Th. Liebisch, formerly professor of mineralogy at Greifswald university, has been called to the Königsberg university. The professorship of physiology at Königsberg has been given to Prof. L. Hermann (Zurich). Dr. L. Königsberger, formerly in Vienna, has been called to the professorship of mathematics at the university of Heidelberg. Dr. P. Dubois-Reymond of Tübingen has accepted a call to the Technical school in Berlin.